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REDUCING IDLE LOSSES WHILE MEETING IEC 62368-1

EDWARD ONG, PRODUCT MARKETING MANAGER AT POWER INTEGRATIONS, EXPLAINS HOW TO REDUCE IDLE LOSSES WHILE MEETING THE LATEST SAFETY REQUIREMENTS IN IEC 62368-1

ARTICLE

ac-dc converters

Manufacturers today are under pressure to improve energy efficiency and finding ways to reduce system losses when the system is idle (no load) has become an important consideration. In equipment ranging from televisions and computers to microwave ovens, fridges, air conditioning systems and printers, every milliwatt saved when the device is waiting idle between operations is vital.

A significant amount of idle power is consumed by the power supply, especially in the EMI filter section. A good example is the energy consumed by the safety discharge resistor placed across the X capacitor. Another contributor to losses is any high-voltage resistor divider network, such as a feedback resistor network. These networks still operate during standby mode and their impact on power consumption can be significant.

To calculate this impact, consider a 1 MΩ discharge resistor. If 230 VAC RMS is applied across it, the loss is equal to the square of the RMS voltage across the resistor divided by the resistor value - in this case 53 mW. This is a common scenario for a 90 W notebook computer, for example. In a 200 W power supply where larger X-capacitors are required, the loss can go up to around 125 mW.

One of the standard circuit techniques to eliminate such idle losses is to open a path during standby mode using an electronically-controlled switch which takes the network offline. ICs are available to perform this function, such as the CapZero-2 two-terminal X capacitor discharge IC from Power Integrations. These devices are rated at 1 kV and can readily withstand surge voltages. CapZero-2 X capacitor discharge ICs are easy to design in and can even be retrofitted into old designs, such as a 200 W power supply in an appliance. The standalone devices can be simply dropped into the circuit, in series with the discharge resistor on the board and losses are immediately reduced. CapZero-2 ICs are already safety certified so all that is needed is an update to the safety file, and one part covers a broad range of X capacitor values.

When AC voltage is applied, it blocks current flow in the X capacitor safety discharge resistors, reducing the power loss to less than 5 mW at 230 V AC. When AC voltage is disconnected, it automatically discharges the X capacitor by connecting the series discharge resistors. This operation allows total flexibility in the choice of the X capacitor to optimise differential mode EMI filtering and reduce inductor costs, with no change in power consumption. Designing with the device is simply a matter of selecting the appropriate external resistor values for the X capacitor value being used to achieve the necessary time-constant.

SAFETY TESTS

However, X capacitor discharge ICs have to be robust so they will not fail even under extreme conditions. This is why the IEC committee was so keen to ensure that proper testing provisions were included for these capacitors when it produced the IEC 62368-1 safety standard.

Although vital and mandatory, this certification can be difficult to achieve with some design techniques, such as using a flyback controller integrated with X capacitor discharge functions, where the designer is forced into using a complicated discharge path. The tests in the standard require the discharge function to happen even in the event of a single fault. Therefore, in this case with the discharge passing through many different components, system reliability is negatively impacted since if just one of those components fails then the discharge cannot happen safely.

CapZero-2 ICs address this issue, as devices still permit a discharge even if there is a fault. The parts have passed severe 8 KV line surges and the devices have been designed with pin redundancy so that even in the case of pin opens or shorts, they will still provide a safe discharge for the X capacitor energy. This allows power supplies to comply with IEC 62368-1, the over-arching safety standard which covers a broad segment of energy-using equipment, and which replaces IEC 60950 for IT equipment and IEC 60065 for television, video and audio equipment. The IEC 62368-1 safety standard was approved and implemented last year and will become mandatory in 2019.

Tests that must be passed include a 120 hour high humidity test. This is carried out at +40 °C and a relative humidity of 93 percent. Other tests include 100 positive and 100 negative impulses of severe line surge. These are done between the line and neutral using a capacitor with the largest capacitance and a resistor with the smallest resistance, and then repeated with a capacitor with the smallest capacitance and a resistor with the largest resistance as recommended by the manufacturer. The time between any two impulses must not be less than one second. Next, 110 percent of the rated AC voltage is applied for two and a half minutes and then the circuit is subjected to 10,000 cycles of power on and off. Again, this is performed using a capacitor with the smallest capacitance and a resistor with the largest resistance, and then repeated with a capacitor with the smallest capacitance and a resistor with the largest resistance as specified by the manufacturer. The power on and off cycle time is not less than one second.

SUMMARY

With the introduction of the CapZero-2 ICs, power supply designers only need to qualify one part number for all their X capacitor discharge IC applications. This increases design flexibility and speeds time-to-market while reducing the resources required to qualify devices. Because CapZero-2 devices are safety-certified to CB and Nemko requirements, developers do not need to perform a separate safety test on the X capacitor discharge circuit of the power supply.

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